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ABSTRACT

The relationship between formal education and creativity was investigated in two studies. A reanalysis of Cox's (1926) 301 geniuses indicated that achieved eminence of creators is a curvilinear inverted-U function of formal education. Secondly, a study of 33 American presidents found that dogmatism (i.e., idealistic inflexibility) is a curvilinear U-shaped function of formal education. Since creativity and dogmatism are negatively associated, and may represent opposite points on a single bipolar personality dimension, these findings imply that the optimal amount of formal education for maximal creative potential is a college experience that falls just short of attaining the baccalaureate degree. Up to the junior year formal education has a positive effect, probably through the acquisition of general knowledge and skills, but thereafter the increased specialization required for graduate and professional training seems to reverse creative growth. It is suggested that this result leads to several questions for further research, including possible implications for the design of postgraduate programs. Other questions for additional research include the following: the magnitude of education's effect upon creative development, whether the curvilinear relationship holds equally well across disciplines, and whether differences in native ability or scholastic performance affect the functional relationship between formal education and creativity. (Author/SW)

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Formal Education, Eminence, and Dogmatism: The Curvilinear Relationship

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HE 013 755

Abstract

Although there have been many investigations into the relationship between formal education and creativity, few have attempted to discover the exact functional curve. Two studies of eminent persons reveal that the relationship may be curvilinear. First, a re-analysis of Cox's 301 geniuses indicates that achieved eminence of creators is a curvilinear inverted-U function of formal education. Second, a study of 33 American presidents found that dogmatism (i.e., idealistic inflexibility) is a curvilinear U-shaped function of formal education. Since creativity and dogmatism are negatively associated, and indeed may represent opposite points on a single bipolar personality dimension, these findings imply that the optimal amount of formal education for maximal creative potential is a college experience which falls just short of attaining the baccalaureate degree. Up to the junior year formal education has a positive effect, probably through the acquisition of general knowledge and skills, but thereafter the increased specialization required for graduate and professional training seems to reverse creative growth. This result leads to several questions for further research, including possible implications for the design of post-graduate programs.

Formal Education, Eminence, and Dogmatism: The Curvilinear Relationship

Research on creativity has long been concerned with the impact of education (e.g., Torrance, 1962). Does education foster or prevent the growth of creative potential? How well do creative youths fit in with traditional educational programs? Most of the empirical investigations on this topic have sampled from contemporary populations of school children, where creativity is usually assessed via some variety of "creativity test" (e.g., Getzels & Jackson, 1962). A much less frequent alternative is to study eminent creators and then determine retrospectively the role of education in their creative development. For example, Hudson (1958) looked at the undergraduate academic records of Fellows of the Royal Society and found their grades generally poor, and definitely not any better than non-Fellows (cf. MacKinnon, 1960). Likewise, Goertzel, Goertzel & Goertzel (1978) inspected biographies of eminent twentieth century personalities to show that the academic performance of creators is often miserable. While these results are consistent with the complaints of many critics of traditional education (e.g., Parnes, 1913), the research on the relationship between education and creativity has failed to consider the precise functional curve between the two crucial variables. The inquiries have just assumed that the function is either positive or negative, but in either case linear. Yet it is very plausible that the relation could be described by a curvilinear inverted-U function. That is, some formal education may encourage creative development -- by promoting the acquisition of requisite knowledge and intellectual skills -- but excessive amounts of academic

training may inculcate an overcommitment to traditional perspectives on artistic and scientific issues. If the functional relation is curvilinear, then the most obvious next question is the location of the optimum point: How much formal education is required to maximize the development of creative potential?

In this paper I will review two investigations which are most germane to this last question. The first study involved the sample of 301 geniuses collected by Cox (1926), the second the much more restricted group of American presidents. Each study approaches creativity in rather different ways, the first by assessing eminence and the second by measuring dogmatism. Nevertheless, we will find that despite the disparity in operationalizations, both studies concur on the functional shape of the curve.

Achieved Eminence: The Cox Sample

The classic methodological difficulty in creativity research is the so-called "criterion problem" (e.g., Taylor, 1964). In designing a "creativity test," how does one go about validation? Evaluations of peers or even of experts are notoriously unreliable, subject as they are to fickle taste and transient fashion. In the final analysis, therefore, creativity must be defined in terms of achieved eminence in a particular cultural activity, whether artistic or scientific. No other operationalization enjoys equal face validity. When we think of creative persons, our minds immediately recall names like Michelangelo, Beethoven, Newton, Descartes, or Tolstoy -- individuals whose contributions to civilization have endured and will in all likelihood continue to endure. Certainly a theory of creativity which fails to explain the emergence of such well-known figures must be judged deficient by lay persons and scientists alike. Francis Galton (1869) was the first to recognize the virtue of employing achieved eminence as a measure, followed

by James McKeen Cattell (1903), another pioneer in psychology. But probably the most significant example is the study by Cox (1926) of 301 geniuses, a study which constitutes the second volume of Terman's (1926) classic Genetic Studies of Genius. Cox took the most eminent creators and leaders on Cattell's list subject to certain restrictions regarding time, place, field, and data reliability. The ranked eminence of these individuals was also taken from Cattell, and therefore was assessed according to the number of lines devoted to each genius in standard reference works. Cox's primary purpose was to demonstrate that ranked eminence and IQ are positively related, a demonstration which she failed to fully accomplish (for the source of spuriousness, see Simonton, 1976, pp. 223-224: cf. Walberg, Rasher & Parkerson, 1980). However, in the process of gathering the requisite biographical data, she did provide enough information which can be used to code a variable of interest to us here, namely, formal education. In an earlier study, the following point system was devised (Simonton, 1976, p. 221):

> no formal education = 0, completed high school or apprenticeship = 1, baccalaureate or equivalent degree = 2, master's degree = 3, and doctorate or other professional degree such as an MD = 4. If an individual fell somewhere between two points on the scale, .5 was added to the lower of the two (e.g., someone who did not finish college received 1.5 points). Neither years of formal education nor any informal education (e.g., studying for the bar) were counted.

I then used multiple regression analysis to determine the effect of formal education on ranked eminence, controlling for such variables as father's status, intelligence, versatility, life span, data reliability, and year of birth. In addition, product terms were introduced to test for both linear and curvilinear relationships and interaction terms were added to see if the functional relation differed between leaders and creators. The outcome was most intriguing. First, in the case of leaders the relationship between achieved eminence and formal education is strictly linear and negative. The highest ranked politicians, generals, admirals, reformers, diplomats, revolutionaries, and religious innovators tend to have the least formal education. Evidently, a Ph.D. does not contribute to the development of leadership ability. Second, the functional relationship for creators is described by a curvilinear inverted-U curve. Hence, I concluded that "up to a point, formal training appears to increase the probability of creative achievement, but too much formal education can actually decrease individual chances of attaining the 'top'" (Simonton, 1976, p. 224). A moderate amount of formal education appears to be best, but what do I mean by "moderate"? As crucial as this question may be for educators, I did not make the answer explicit in the earlier article (cf. Bennett, 1980). Nonetheless, by applying a little calculus and some analytic geometry to the published regression equation, it is possible to graph the functions. These graphs appear in Figure 1.

Insert Figure 1 about here

Here we see most clearly the general negative linear function for leaders and the curvilinear inverted-U function for creators. The latter

curve is by far the most interesting. In the first place, it is most fascinating to find that creators with doctorates tend to be slightly less eminent than those with very little formal education at all. Even more critically, the peak of the curve is at 1.85 on the scale, a value which translates as a college education to a point just short of a bachelor's degree. That is, the most eminent creators -- scientists, philosophers, writers, artists, and composers -- tend to complete their junior years but do not go on to finish their senior years so as to earn the degree. Apparently, college education can be a very enriching experience so long as it concentrates on a broad "liberal arts" education, but once the student is obliged to become more specialized by taking "upper division" courses in his or her major, the effect becomes more detrimental to creative development. Perhaps this finding by itself does not deserve to be assigned too much weight, at least not without further empirical collaboration. Yet such additional support is immediately forthcoming in the next section, and from a totally different direction.

Dogmatism: Presidents of the United States

Maranell (1970) had 571 American historians rate 33 U.S. presidents on general prestige, strength of action, presidential activeness, idealism versus practicality, flexibility, administration accomplishments, and respondant's amount of information. These ratings included all presidents before Nixon except for two presidents with excessively brief terms (viz. Garfield and W. Harrison). A principle axes analysis of these seven measures yielded two factors accounting for 85% of the explained variance (Simonton, Note 1; cf. Wendt & Light, 1976). The first factor consists of all measures except the idealism versus practicality and the flexibility ratings, with factor loadings from .840 to .998, and it accounts for 84% of the explained

variance. This factor was called "presidential greatness" and factor scores were produced by samply summing the raw scores for the five component measures. The coefficient alpha for the resulting composite is a highly respectable .98. The second factor is strictly bipolar, consisting of flexibility with a high positive loading and idealism versus practicality with a moderate negative loading -- a factor clearly contrasting pragmatic flexibility against idealistic inflexibility. Because flexibility has double the factor loading of idealism, this factor should be labelled a "dogmatism" dimension. A composite measure of "presidential dogmatism" was accordingly produced by subtracting the score on flexibility from the score on idealism versus practicality. Since this measure contains only two items and is generated by a difference score, coefficient alpha is only .49. Nonetheless, it is important to point out that the results to be reported here hold not only for the dogmatism indicator, but also for each of its two components separately, though in the opposite direction as befits their negative relationship.

Formal education was operationalized using a scale only slightly modified from Simonton (1976): 1 point if attended college, 2 points if a college graduate, 3 points if earned a master's degree, and 4 points if earned a Ph.D. (Simonton, Note 1). The reason for this slight modification is that the vast majority of presidents, being largely either lawyers or army generals, are college educated to some extent. In any case, to check for a curvilinear relation, this variable was also put in mean-deviation form and squared. Both greatness and dogmatism measures were then regressed on the linear and quadratic functions of formal education, along with a large number of control variables (Simonton, Note 1). Presidential greatness bore no relationship with formal education, whether linear or curvilinear. This outcome may be interpreted as conflicting with the negative relation

between eminent leadership and formal education found for the Cox data. However, not only may greatness be somewhat separate from eminence (cf. Simonton, 1977), but moreover the U.S. presidents may provide far too homogeneous a group for fair comparisons to be made with the leaders in the Cox sample.

Formal education does have a noticeable impact upon presidential dogmatism, however, as can be judged from Figure 2. Here we observe a curvilinear U-shaped relationship between formal education and assessed dogmatism. The most dogmatic presidents are those who either have very little formal education (such as Andrew Johnson who was actually illiterate until his late teens) or have Ph.D.'s (such as Wilson who is the only president with a doctorate). On the other hand, the least dogmatic presidents tend to have a moderate amount of formal education, the low point occurring at 1.53. This minimum is remarkably close to the maximum witnessed in Figure 1 for eminent creativity, at least once we provide for the light difference in the two scales. A minimum of 1.53 in Figure 2 converts to a value of 1.76 in Figure 1, a value strikingly similar to the observed maximum at 1.85. The curves for dogmatism and for eminent creativity are virtually mirror images of each other! Thus some college education just short of a baccalaureate degree tends to lessen idealistic inflexibility, the most amount of such reduction occurring by the end of the junior year. Evidently, the liberal arts exposure in the first years of college widens the student's outlook and provides him or her with the intellectual tools and information to think in a practical and flexible manner. After the junior year, increased formal education tends to undermine this pragmatic flexibility in the process of training a more academic, ivory-tower intellect.[1]

Insert Figure 2 about here

Naturally, what makes the above finding most valuable is that dogmatism and creativity cannot be considered independent, orthogonal dimensions of human information processing. On the contrary, there is ample evidence that these two constructs represent opposite ends of a bipolar dimension. Certainly creativity is negatively associated with authoritarianism (Grossman & Eisenman, 1971), rigidity (Leach, 1967), and dogmatism (Uhes & Shaver, 1970). And the general personality characteristics of creative individuals tend to be almost identical to persons low in dogmatism or authoritarianism (for example, compare Stein, 1969, with Rokeach, 1960, or Adorno, Frenkel-Brunswick, Levinson, & Sanford, 1950). In a nutshell, creativity requires flexibility. Hence, the observed relationship between formal education and eminent creativity can be said to be independently substantiated by the mirror reflection found between formal education and dogmatism.

Conclusion

Obviously, the above evidence suggests that formal education may have very mixed repercussions for creative development. Up to the first couple years of college, the acquisition of formal education tends to increase creative potential and reduce dogmatism. Yet the specialization which takes place in the last year of undergraduate training may turn this beneficial influence completely around. The ultimate outcome is an individual who is less likely to achieve eminence as a creator and who is more prone to exhibit idealistic inflexibility. Obtaining the doctorate marks the nadir in creative potential and the acme in dogmatism. Higher education is thus a very mixed

blessing. Moderate amounts provide the individual with the basic information and techniques sine qua non of success in any field, while extreme amounts produce negative transfer. The over-trained student may overconform to conventional viewpoints on central artistic and scientific problems and thereby become less apt to revolutionize their disciplines. However, I think it is still too early to defend a broad condemnation of advanced education. Rather, the two studies reviewed here should be adopted as points of departure for further research. Future investigations should concentrate on the following five critical questions:

1. What precisely is the magnitude of education's effect upon creative development? Is the effect size so large as to signal a virtual crisis or so tiny as to be negligible? The pair of investigations discussed above offer tentative even if not perfectly concordant answers. In the case of achieved eminence as a creator, about 2% of the total variance can be uniquely accounted by formal education. Whether this percentage should be taken as large or small mostly depends on one's outlook. My own inclination is to see 2% as a substantively significant proportion of variance. In the first place, this figure represents only the unique impact of formal education, excluding any variance that predictor may share with other variables in the equation (e.g., socioeconomic status and IQ). Even more critically, I personally believe that achieved eminence in any creative endeavor is a very complex phenomenon with multiple determinants, some physiological, others psychological, and yet others sociocultural (Simonton, 1978). If genius has some four dozen predictors, the unique contribution of each single predictor can only average around 2% of the variance anyway. Finally, this 2% of the total variance translates into almost 9% of the explained variance. That is,

within a regression equation consisting of almost two dozen variables, about 9% of the total predictive power of the equation can be ascribed to formal education. Thus, the impact of this predictor cannot be ignored, especially given its even greater significance in predicting presidential dogmatism. About 13% of the total (or 23% of the predicted) variance in idealistic inflexibility can be uniquely attributed to formal education. So any detrimental consequences of formal education deserve serious consideration in future research.

2. Does the curvilinear relationship hold equally well across disciplines? Given the very different functions for leaders and creators, the response to this question may be negative. In particular, it is likely that artistic and scientific activity may each require different amounts of formal education for optimal creative development. Hudson (1966), for example, has indicated that "divergent" thought processes may be more necessary for artistic creativity, "convergent" processes more mandatory for scientific creativity, where traditional educational techniques favor convergent over divergent cognition (cf. Haddon & Lytton, 1968). Likewise, Schaefer and Anastasi (1968) have shown that the academic records of creative adolescents in the sciences tend to be superior to those in the arts. When we consider the severe complexity and sophistication of modern science, it seems probable that even if the function is curvilinear, the peak is shifted towards higher amounts of formal education. Perhaps the optimum point is the doctorate, any decline appearing during postdoctoral training (cf. Zuckerman, 1977). Unfortunately, the number of scientists included in the Cox sample is far too small to answer this question now. Still, I should point out one counter-argument.

It may very well be that formal education is conducive to achievement in "normal science," but not to becoming a truly revolutionary scientist (cf. Kuhn, 1970). Isaac Newton went no further than a baccalaureate degree, and in the twentieth century Albert Einstein did not have good enough grades to go on to graduate school. Einstein was obliged to acquire his doctorate not through formal training but rather by submitting one of his publications for consideration as a dissertation while he was working full-time in a Swiss patent office. Thus truly revolutionary scientists may display curvilinear relationships not unlike those found for artists (cf. Koestler, 1964).

3. Is the observed relationship between formal education and creativity transhistorically invariant? Proponents of higher education are no doubt free to draw the defense that "times have changed" since the Cox sample was taken. After all, those 301 geniuses come from the fourteenth through nineteenth centuries before the advent of our intricate twentieth century society and equally prior to the extensive democratization of higher education. Be that as it may, there are several reasons for tentatively accepting the transhistorical invariance of the discovered relationship, at least until further research indicates otherwise. To begin with, trend analysis of the formal educational levels achieved by the 301 geniuses reveals no general tendency for the amount of such education to increase over time (Simonton, 1976). Moreover, the study of presidential dogmatism revealed a mirror-image curve for the antithesis of creativity even though that sample consists of primarily nineteenth and twentieth century historical figures. Thus although the average birth date for the Cox and president samples are over a century apart (1705 versus 1820, respectively), they agree almost perfectly that the turn-around

point occurs just after the junior year of college. A function which has been valid from Leonardo da Vinci through President L.B. Johnson may continue to be so in the future. In addition, empirical studies of contemporary populations have noted the decline in creativity scores during the college years, especially upon entrance into programs of augmented specialization (e.g., Eisenman, 1970). Finally, we must recognize that the increased complexity and sophistication of a society may require more formal education on the part of its "technocrats" or "mandarins," but that requirement may nevertheless exert an adverse effect on creativity in that culture. Byzantine society was a massively intricate culture dedicated to preserving the best of Classical and Christian traditions. Success of Byzantine scholars demanded an awesome erudition far surpassing that demanded of their predecessors in the Golden Age of Greece. Yet the Byzantine world, for all its ability to survive with sporadic flashes of splendor, exhibited very little creativity. Byzantine civilization acted not so much as a stimulant to cultural advance but rather as an effective formaldehyde.

4. Do differences in native ability or scholastic performance affect the functional relationship between formal education and creativity? Let us suppose for the moment that excessive formal education tends to reverse creative development by narrowing the student's breadth of perspective and flexibility. That is, advanced levels of education may oblige the student to become too committed to traditional ways of approaching major problems, and this commitment produces a negative set against the discovery of truly novel ideas. Given this supposition we may then ask if there are any ways that the student may shake off these detrimental influences despite the

attainment of higher degrees. I see two major possibilities. First, the greater the student's native intelligence, the less time he or she must devote to mastering the educational materials, and hence the more time remaining for "extracurricular activities" which serve to maintain if not improve breadth of perspective and intellectual flexibility (cf. White, 1931). Less able students are forced to devote full time to their studies, with little time left for extracurricular enrichment. To be sure, the knowledge to be mastered in graduate school demands more "brain power" than that in undergraduate school, and thus even the very bright student may have little free time when seeking an advanced degree. Even so, the peak point in the curve may be shifted upwards towards higher amounts of formal education in the case of the extremely gifted. Naturally, the foregoing argument assumes that all students, gifted and less gifted alike, are working for the top grades requisite for continuing up the educational ladder. This assumption brings me to my second point: Students may avoid some of the negative effects of formal education by not seeking straight-A grade point averages. At the beginning of this paper I pointed out that creative persons are not necessarily superior students. By not attempting to attain the highest grades, students are free to continue their quest for a general education untramelled by the requirements of specialization. Thus, those students who do not get the best grades may actually be able to attain higher levels of formal education without negative consequences for creative development. Altogether, then, the optimal point of the curve may be shifted upwards for those students either who enjoy higher native ability or who are not committed to the highest scholastic performance. The common factor to both escape routes is how much time the student has to continue a more general education outside the classroom.

5. The final question emerges quite naturally from the above discussion: Can reforms be introduced to make the impact of formal education more positive in our graduate and professional schools? Normally, a general "liberal arts" education is acquired during the first couple of years in college, after which specialization occurs in the guise of upper division courses in a chosen major. By the senior year, exposure to a broad range of ideas in a wide array of disciplines has practically ceased. And, of course, this narrowing of the educational focus continues with a vengence in graduate, law, medical, business, or other professional schools. Therefore, the most immediate way of limiting the decline in creative potential in postgraduate programs is to somehow encourage the continued acquisition of general knowledge and skills during this phase of specialization. One means for accomplishing this task is to set up interdisciplinary seminars which try to demolish the walls between disciplines and between the academic world and the lay community. Another means may be to take steps to discourage excessive competition which tends to leave graduate and professional students with far too little time for outside activities, intellectual or otherwise. Naturally, directors of graduate and professional schools may argue that they are not in the business of creating geniuses, but rather only in producing competent academicians, doctors, lawyers, business executives, or other professionals. Very true. But few would maintain that we do not need major innovators in any of these professional endeavors. And even if creativity is unsought, all professions may gain by the persistent development of well-rounded personalities. As a consequence, the future may see fewer scientists doing research in naive ignorance of the ethical ramifications of their work or fewer doctors or lawyers divorcing their own personal concerns from the needs

of the larger society upon which they must ultimately depend. Thus the upshot may not only be more creative minds to spur intellectual, cultural, technological, and economic progress, but additionally a professional establishment which is better integrated with the community as a whole.

I am compelled to reiterate a caveat: Without further research along the lines indicated by the foregoing five questions, the empirical relationship between formal education and creativity should not be applied uncritically to practical decisions. In the first place, even though excessive formal education may have a debilitating impact upon creative development, the fact remains that formal education exerts a beneficial influence almost to the end of college. Thus primary and secondary school teachers, and even college professors primarily engaged in undergraduate instruction, should not feel that they are stifling potential genius in their classrooms or lecture halls. So most educators have no real cause for guilt or dispair given that the vast majority are contributing to the creative development of their students. And the high school student should not decide not to go to college for fear of being inculcated with an ivory-tower idealistic inflexibility and intellectual or artistic conformity. After all, a college education may be conducive to creative development so long as it concentrates on the mastery of general knowledge and skills. Moreover, we all must keep in mind that the adverse effect of more advanced training concerns only the greatest of the great -- the top hundred or so of eminent creators.[2] Most of us would no doubt rest in peace even if we were the most meagre runner-up, with a rank somewhere in the thousands or ten thousands. A typical Who's Who contains thousands of entries, and yet who does not sense the honor of having a puny paragraph with a most familiar name hidden amongst the many?

So if your ambition is not to rival Michelangelo, Newton, Beethoven, or Shakespeare in the annals of history, why worry about finally finishing your doctoral dissertation? And certainly if you do take that last fatal step, who is to say that other causal factors will not compensate for the damage done, and even propel you to the top despite your thesis? Hence, for my part, I have not regretted earning by Ph.D.!

Reference Note

1. Simonton, D.K. Presidential greatness, dogmatism, and performance: Can we predict leadership in the White House? Manuscript submitted for publication, 1980.

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Footnotes

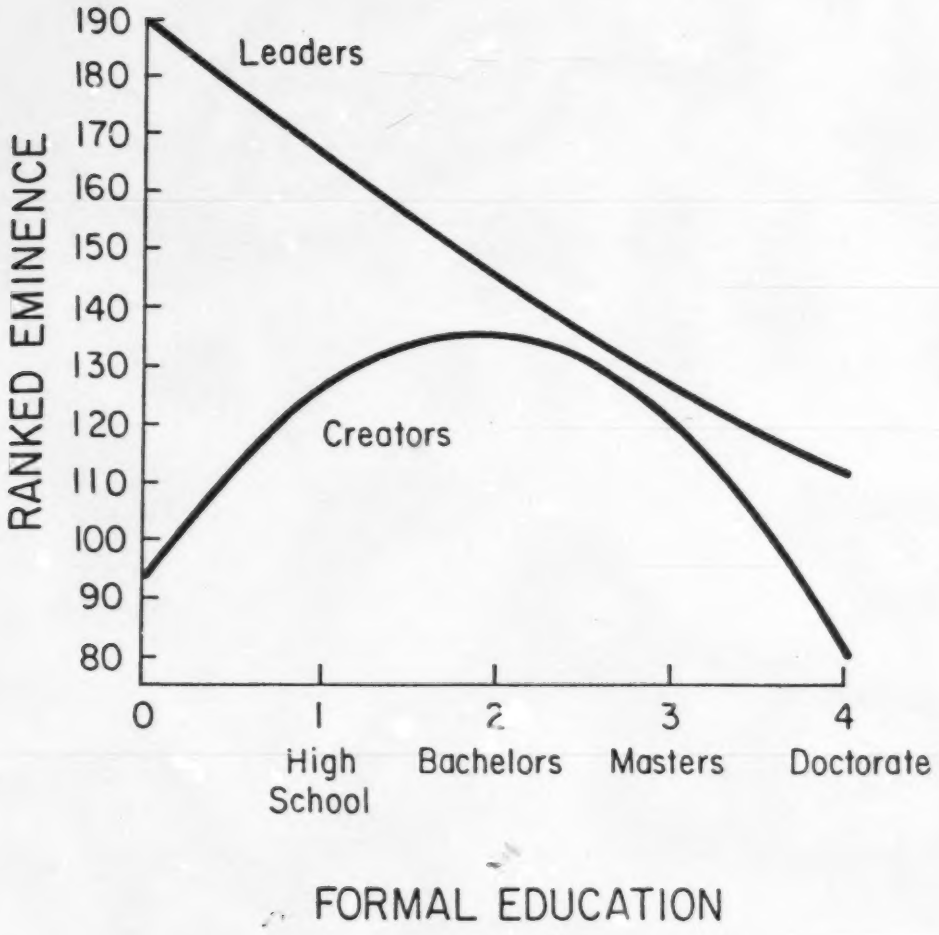
1. This study also found that presidents with prior experience as college professors tend to be the most dogmatic, even after controlling for amount of formal education. Evidently, continued association with the academic milieu tends to be associated with an impractical ivory-tower rigidity.

2. There is an alternative explanation which deserves mentioning. Maybe the greatest minds avoid postgraduate programs because (a) they know the experience would undermine their creativity (b) they do not believe they need the further training, or (c) they feel that they can acquire any additional information or techniques on their own. In other words, the geniuses of the highest rank may select themselves out of graduate or professional schools.

Figure Captions

Figure 1. Curves for relationship between formal education and ranked eminence for leaders and creators from the Cox sample of 301 geniuses.

Figure 2. Curve for relationship between formal education and dogmatism (i.e., idealistic inflexibility) for 33 American presidents.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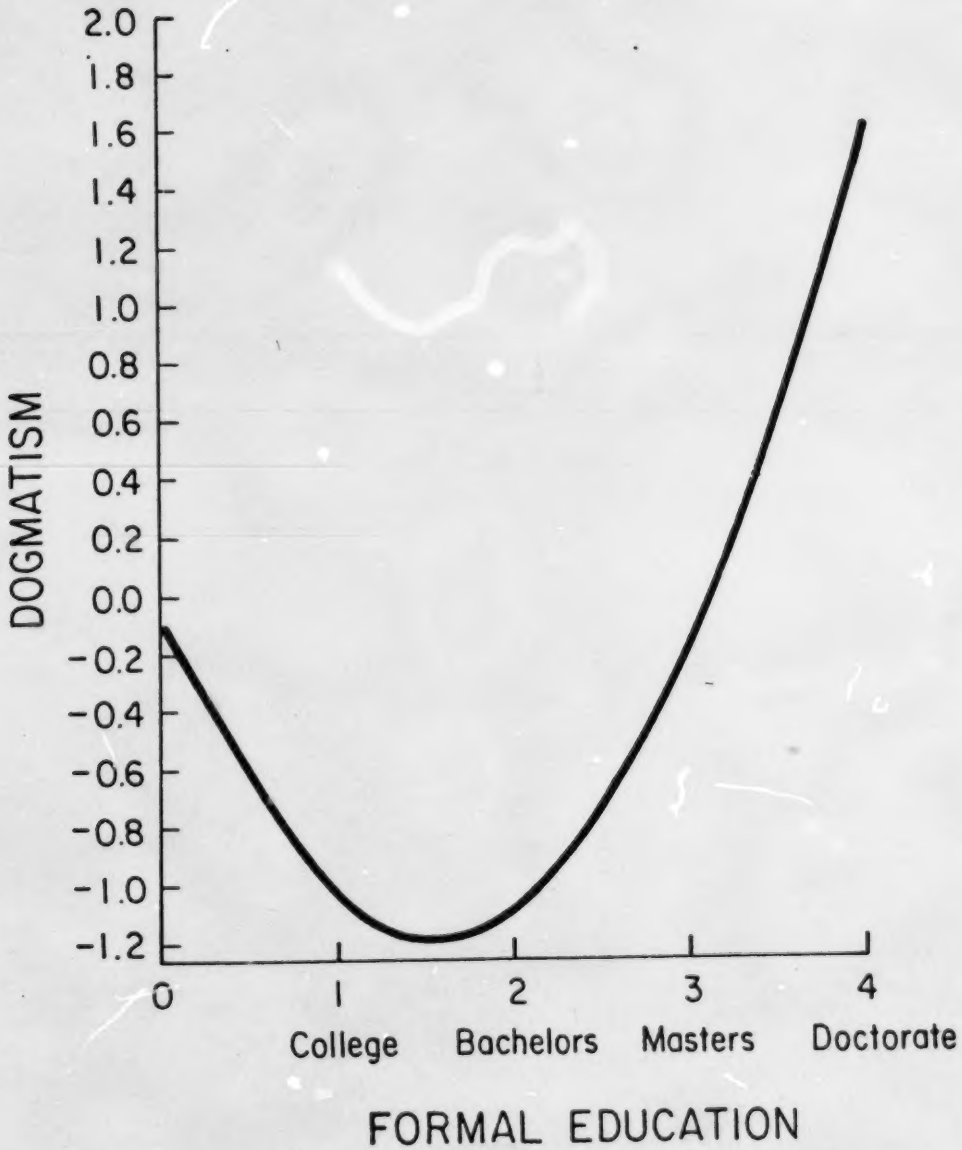
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College
Bachelors
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FORMAL EDUCATION